Optical Networking Industry Technologies

Integrated Optical Systems

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>THIS IS NORTEL

Nortel R&E The Early Years

> UCAID/Internet 2 1997
- Qwest/Nortel OC-192 backbone
- Cisco/Juniper routed network
- Internet 2 committee participation

> NTON-2A 1998-2002
- 6-member DARPA-funded consortium led by Nortel
- Applications & network research
- Seattle–San Diego DWDM OC-192 Classic
- 8-lambda OM5200 SF-bay area ring for OC-12/48 and gigE
- Avici TSR, Passport 15K, OMM 8x8 MEMs switch
- PetaWeb NGI research
- Supercomputer HPC events in 1999, 2000, 2001
- GST Chapter 11

High Research Success
Low community recognition

Making History

OMNInet (mk1 2002 – 2005

- **3-way partnership iCAIR/Northwestern University, Nortel, SP**
- **Metro Scale 10GE LAN and experimental Photonic Switching**
- **Early Control Plane & Impairment experiments**

SURFnet 2004-

- **World-leading R&E network in Netherlands**
- **Hybrid optical packet dynamically provisioned network**
- **Shift from Routed Networks to Optical Light-paths and Photonic Switching**

CA*net-4 2004-

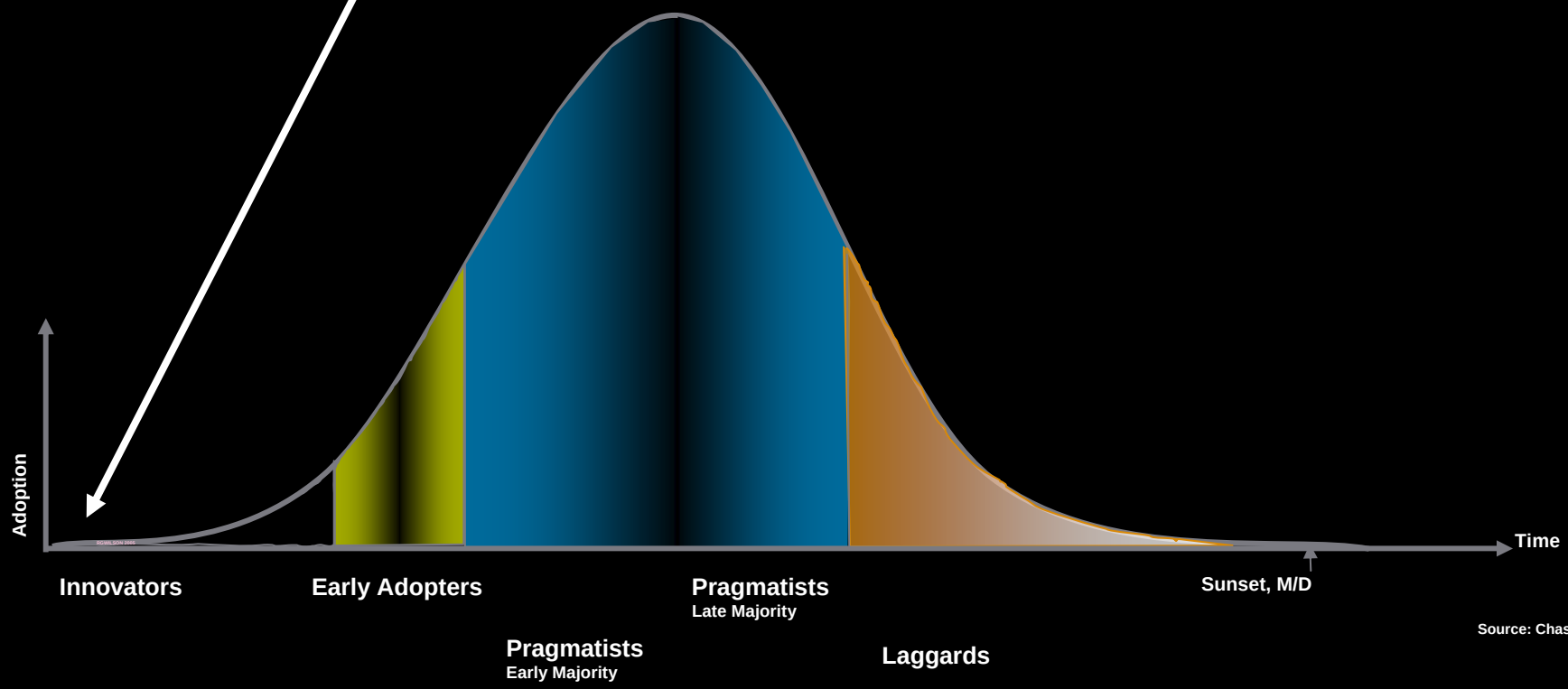
- **Expansion based on HDXc, OME 6500 and CPL**
- **GLIF/GOLE switching at Seattle and Chicago**
- **DRAC and UCLP interoperability**

Texas LEARN

- **Educational Networks Leadership**
- **Nortel CPL & DWDM OM5200 ,**
- **Infrastructure first.. Research next**
- **Next-generation network architecture**

Research and Experimental Networks, Technology Adoption Life-cycle

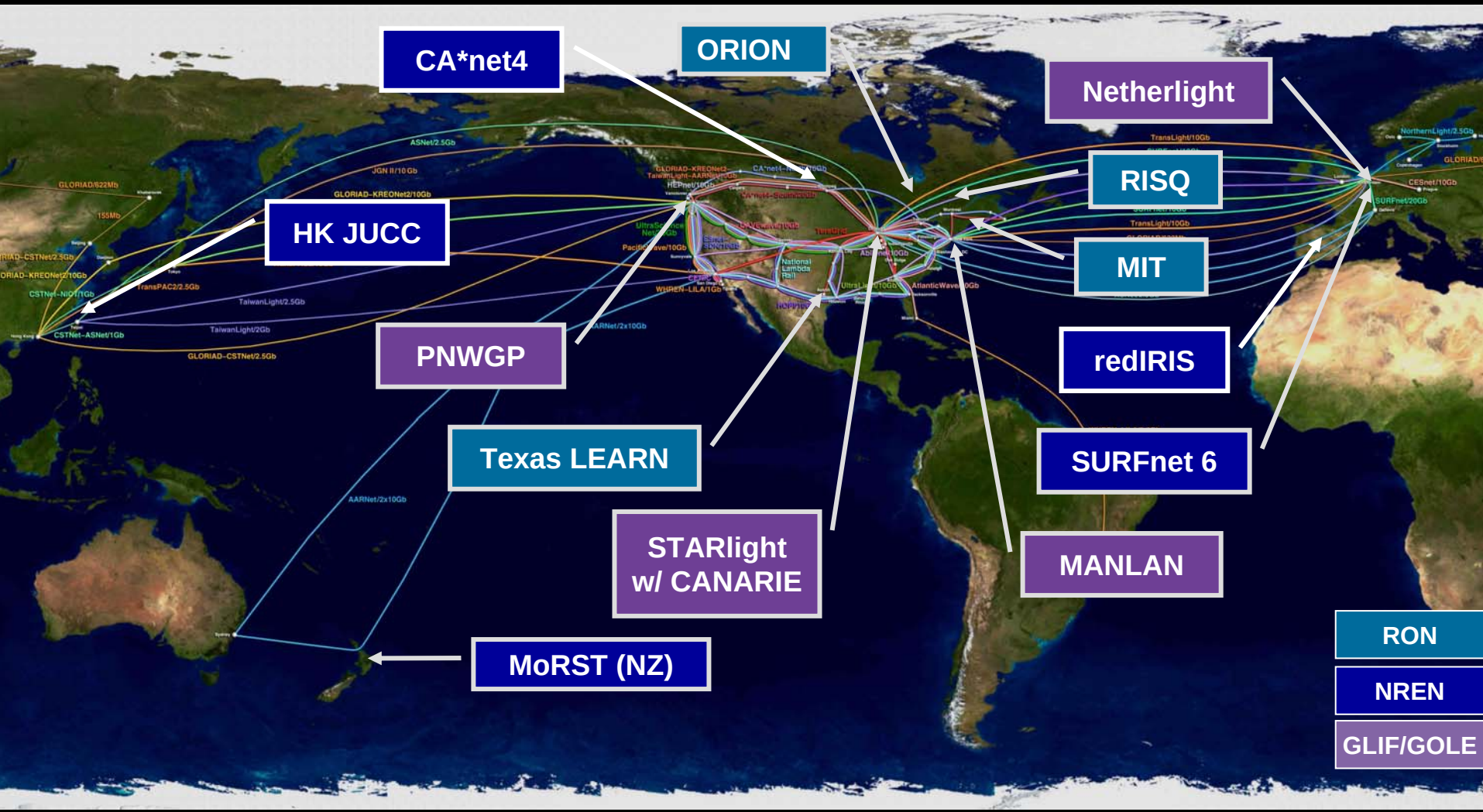
WE ARE HERE: Research and Experimental Networks
Partnership and Collaboration Program
Advanced Technology Research
CTO Group, Nortel Networks



- Seek innovators collaborators and partners in the broad research community to discover NGN's
- Build experimental and test-bed networks for advanced technology prototypes ~ proofs
- Create synergistic "inside Nortel" transition points for technology flow and product / business growth

Global Lambda Integrated Facility World Map

R&E Networks using Nortel optical technology (Aug 2006)



Visualization courtesy of Bob Patterson, NCSA/University of Illinois at Urbana-Champaign.
Data compilation by Maxine Brown, University of Illinois at Chicago. Earth texture from NASA. (Aug 2005)

Integrated Optical System

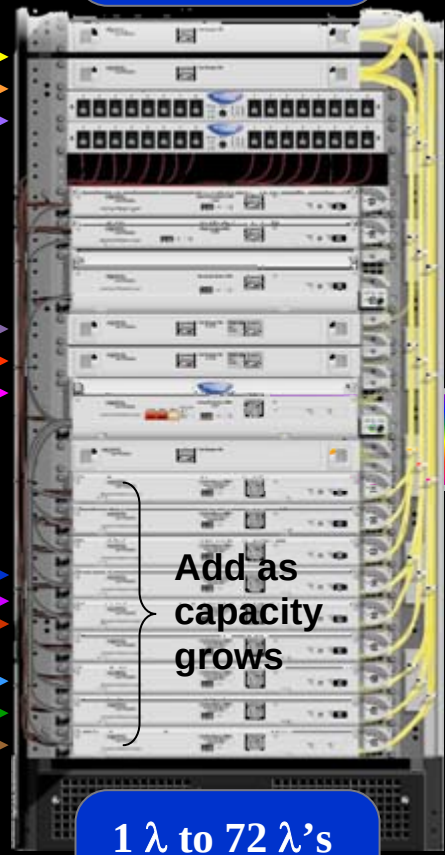
OME 6500
Non-blocking 160Gbps
SONET/SDH OXC
10GE LAN/WAN
eDCO, EPL, L2SS
GFP/VCAT/LCAS
L0/1/2 & 40Gbps ready

HDXc
Non-blocking 640 Gbps
SONET/SDH OXC
OC-n / GbE / DWDM
GFP/VCAT/LCAS
Pluggable optics
L0/1 & 40G ready

OM 5200
1-64λ C/DWDM
OC-n / 10GE
GbE / FC / FICON
600 km reach
EPL / GFP / VCAT
Pluggable optics

Nortel or Vendor "X"

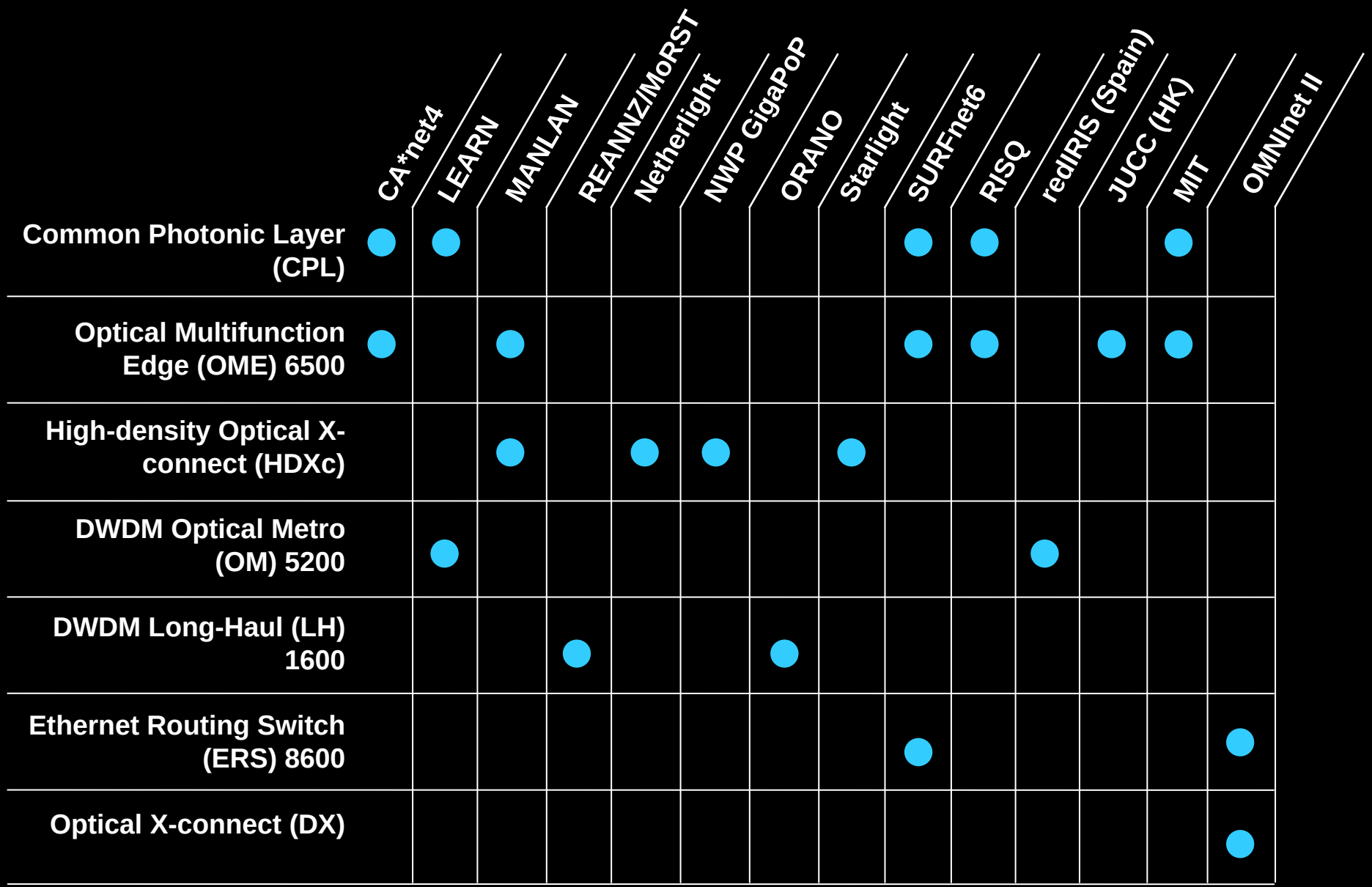
Common Photonic Layer (CPL)



Add as capacity grows

1 λ to 72 λ's
(Up to ½ rack
425 Watts)

Nortel Technology in R&E Networks



SURFnet6 on dark fiber

- SURFnet6 is based on converged / integrated Optical systems. Common Photonic Layer
- Spectacular collaborative environment…shared pride in accomplishments
- Creative test bed infrastructure for next gen. research about network technologies.

CANARIE/ORANO Network

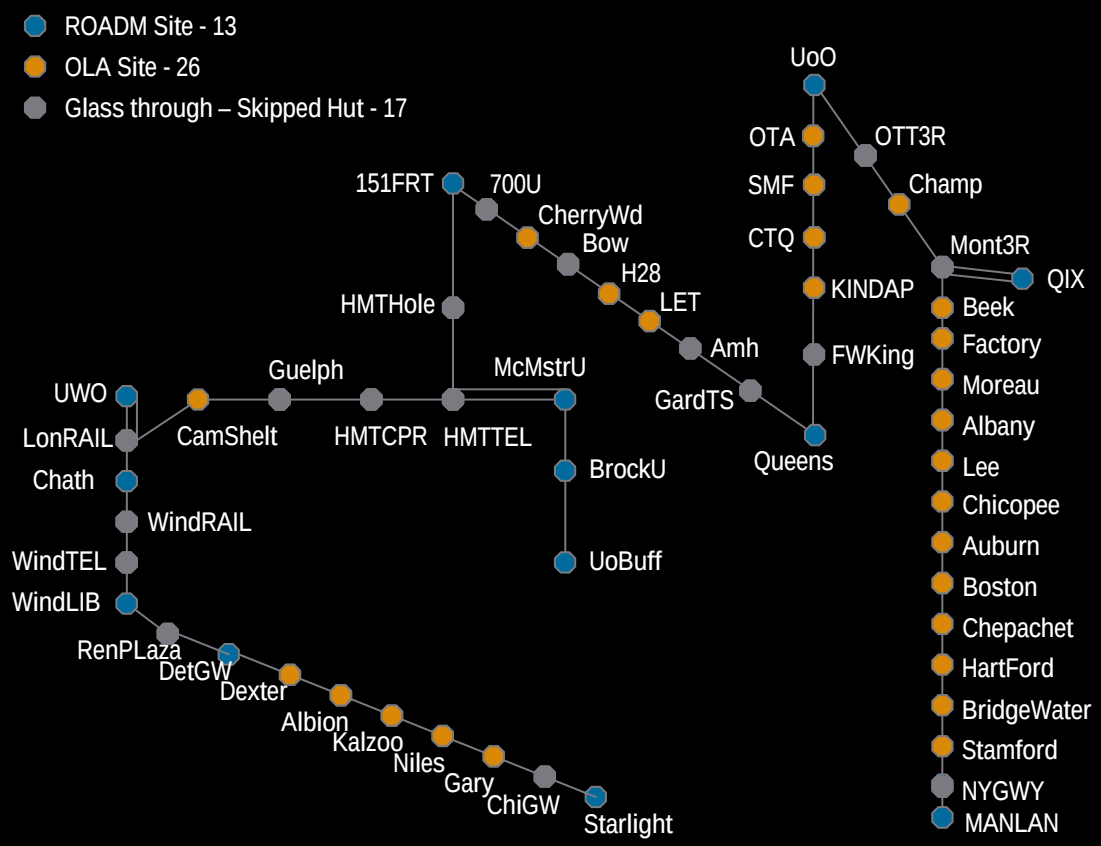
CANARIE – Canadian National Research Network
ORANO – Ontario Provincial Network

Single DWDM Layer Network Sharing Research/Production/Network Testing

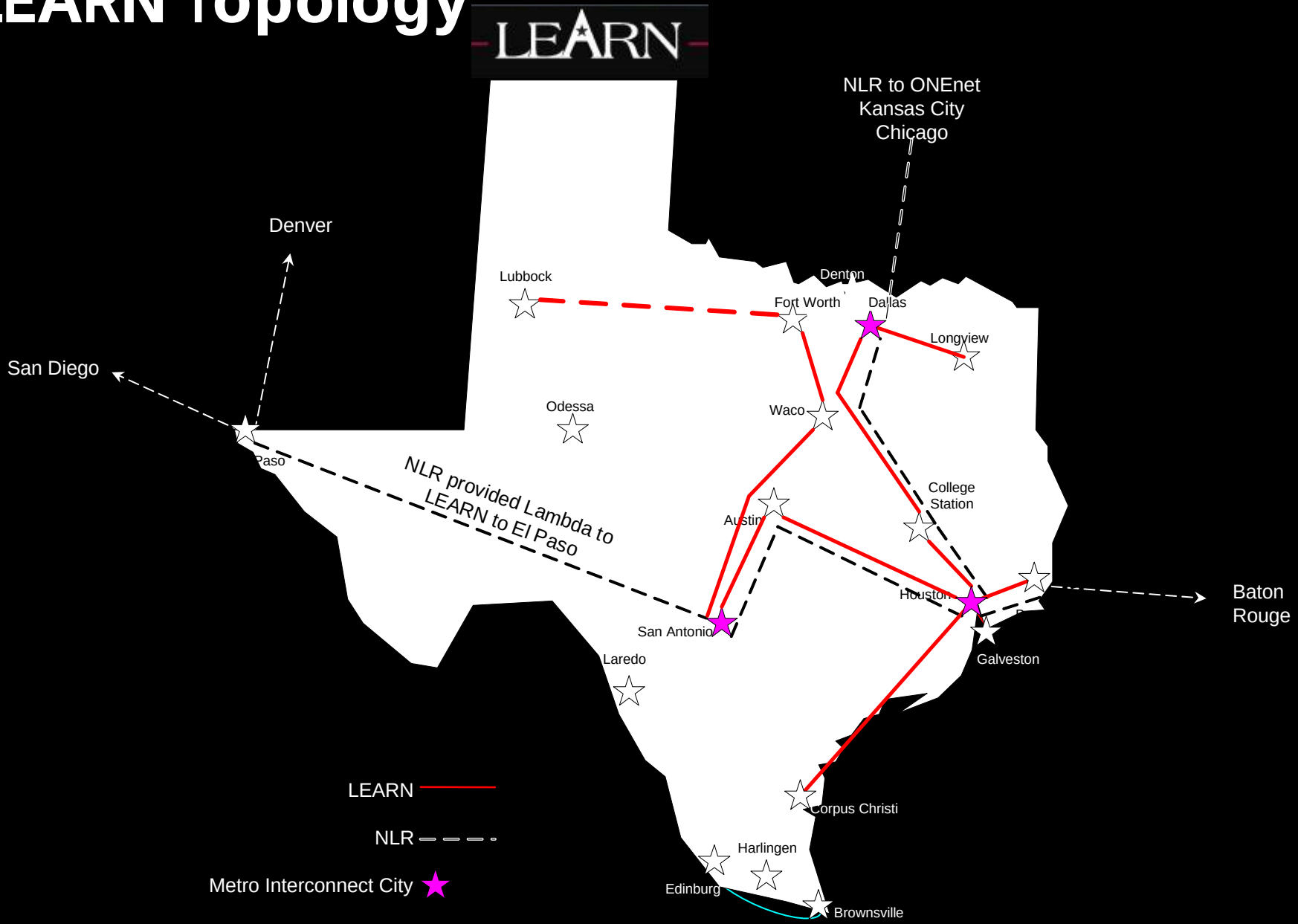
Shared owned and managed

L1 and L0 services GE/10GE/wavelengths 99.999% Availability

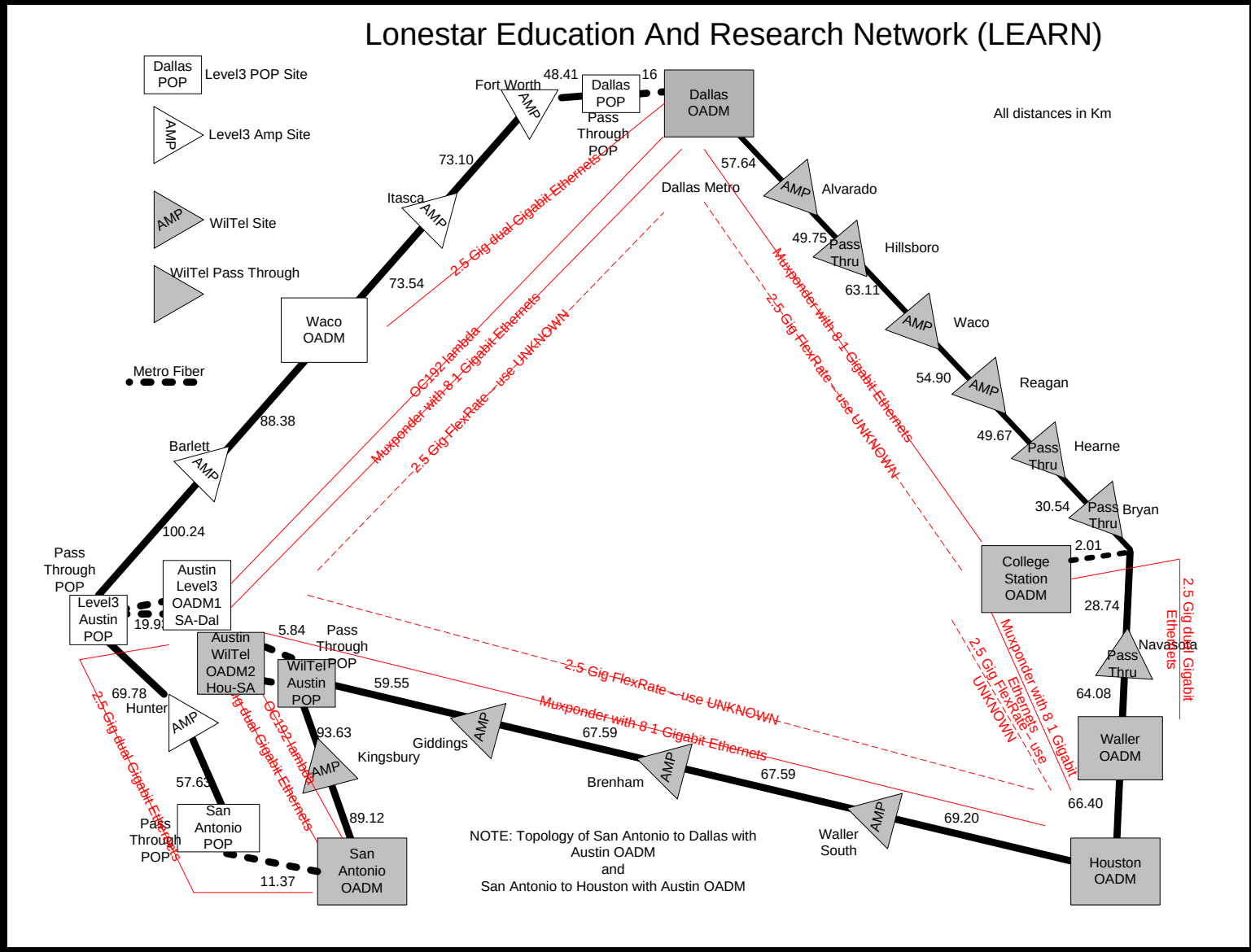
Universities, Government Labs, National and Provincial Government



LEARN Topology

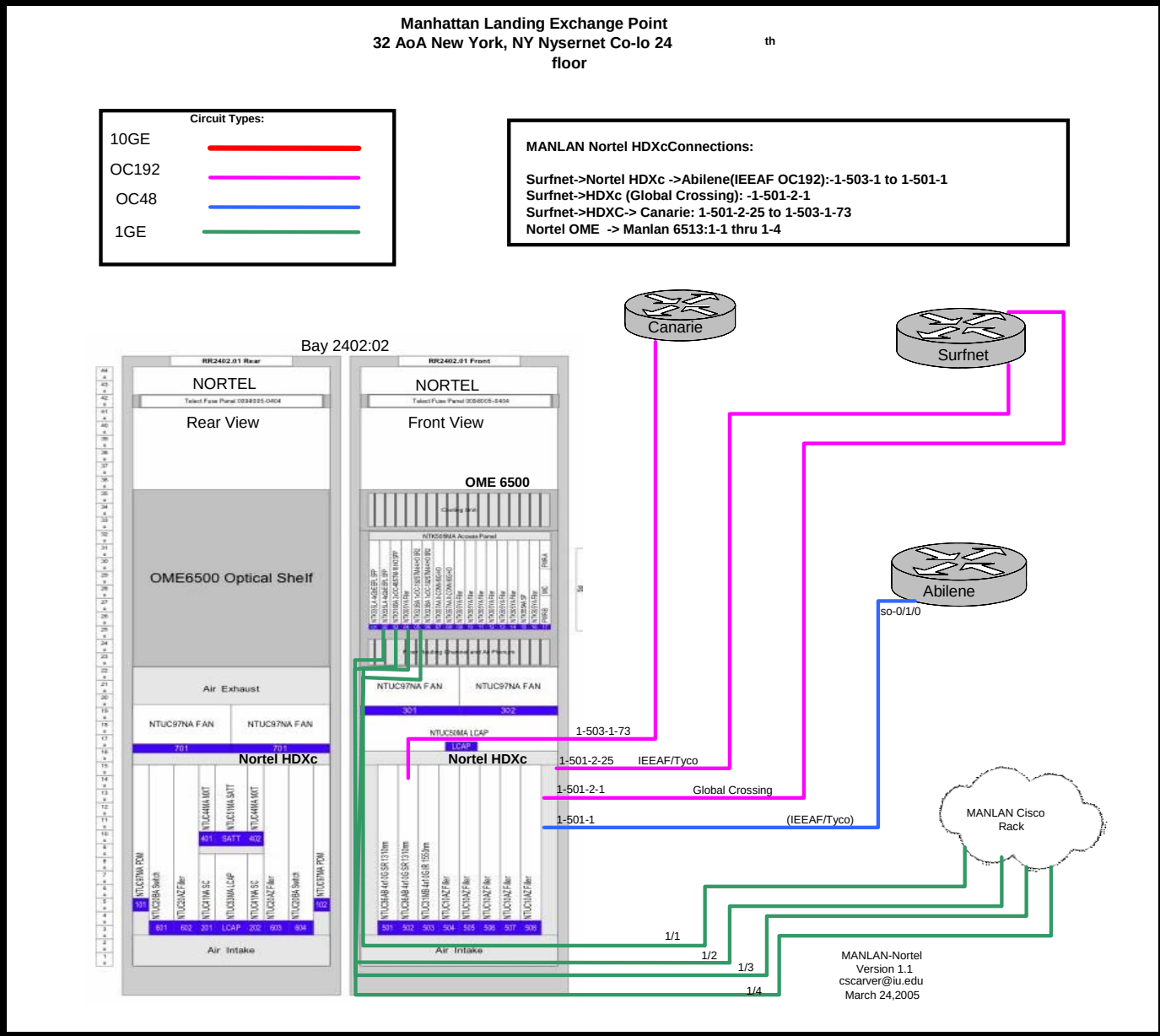


LEARN Triangle Backbone Engineering

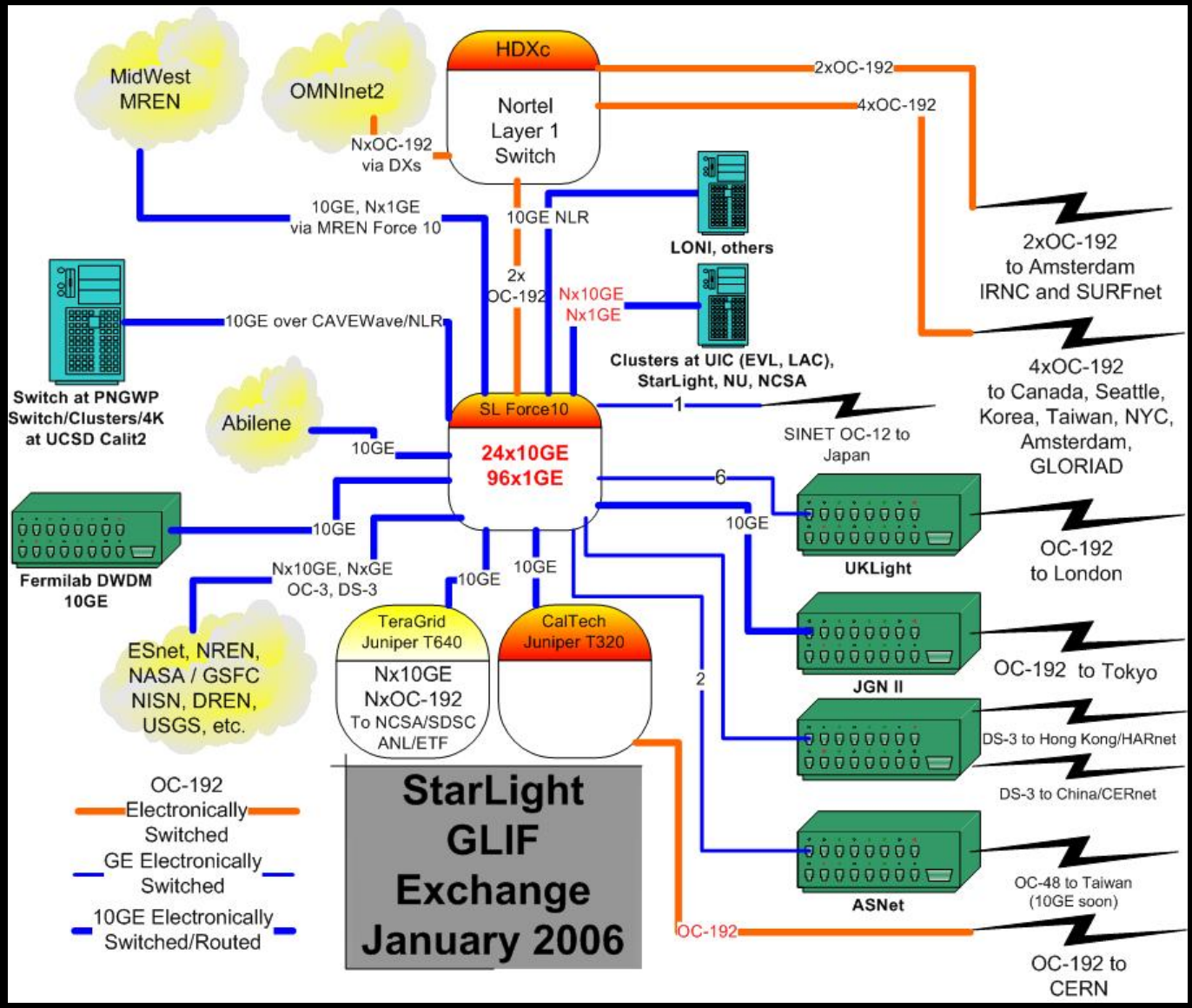


MANLAN GLIF Node

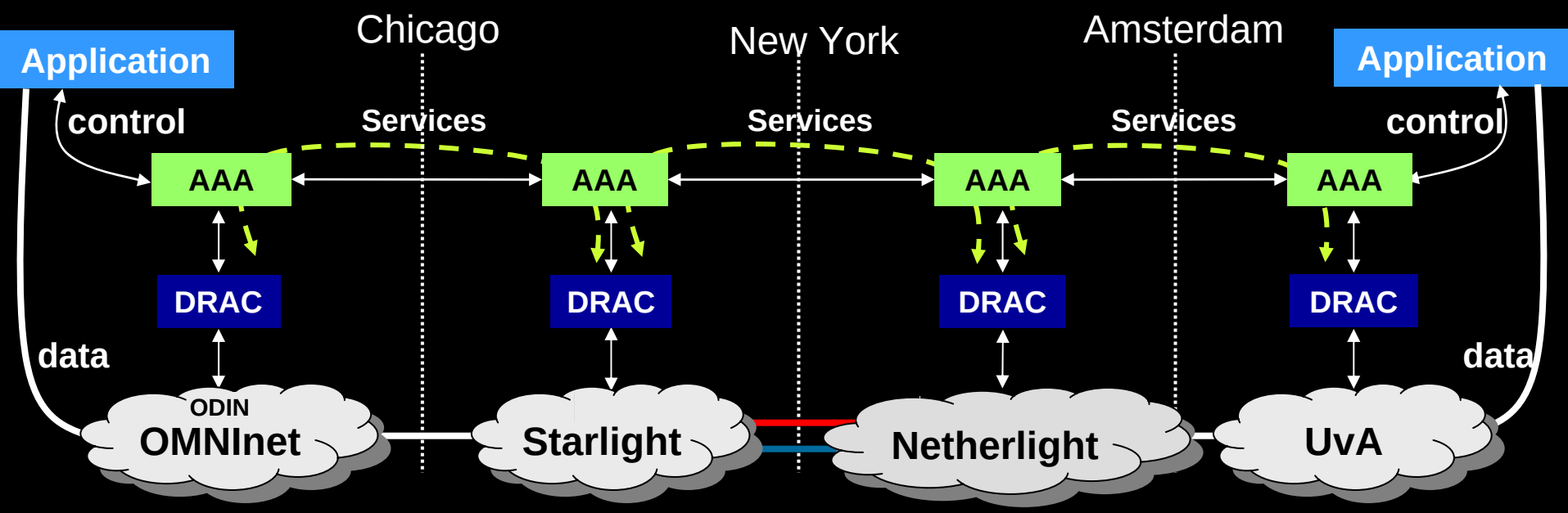
Nortel OME6500 & HDXc



StarLight GLIF Node Configuration



Conduct Hero Demonstrations as technology and leadership proof points. eg: DRAC Demonstrator – SC|04



- Create multi-domain intercontinental lightpath network (commandeer lightpaths on 5 separate networks)
- Prove scalability and intra / inter-domain fault recovery
- thru layering of a novel SOA upon legacy control planes and NEs

COLLABORATION

CANARIE NETWORKS > COLLABORATION > RESULTS
RÉSEAUX > COLLABORATION > RÉSULTATS

GigaPort

glif

iCAIR

INTERNET2

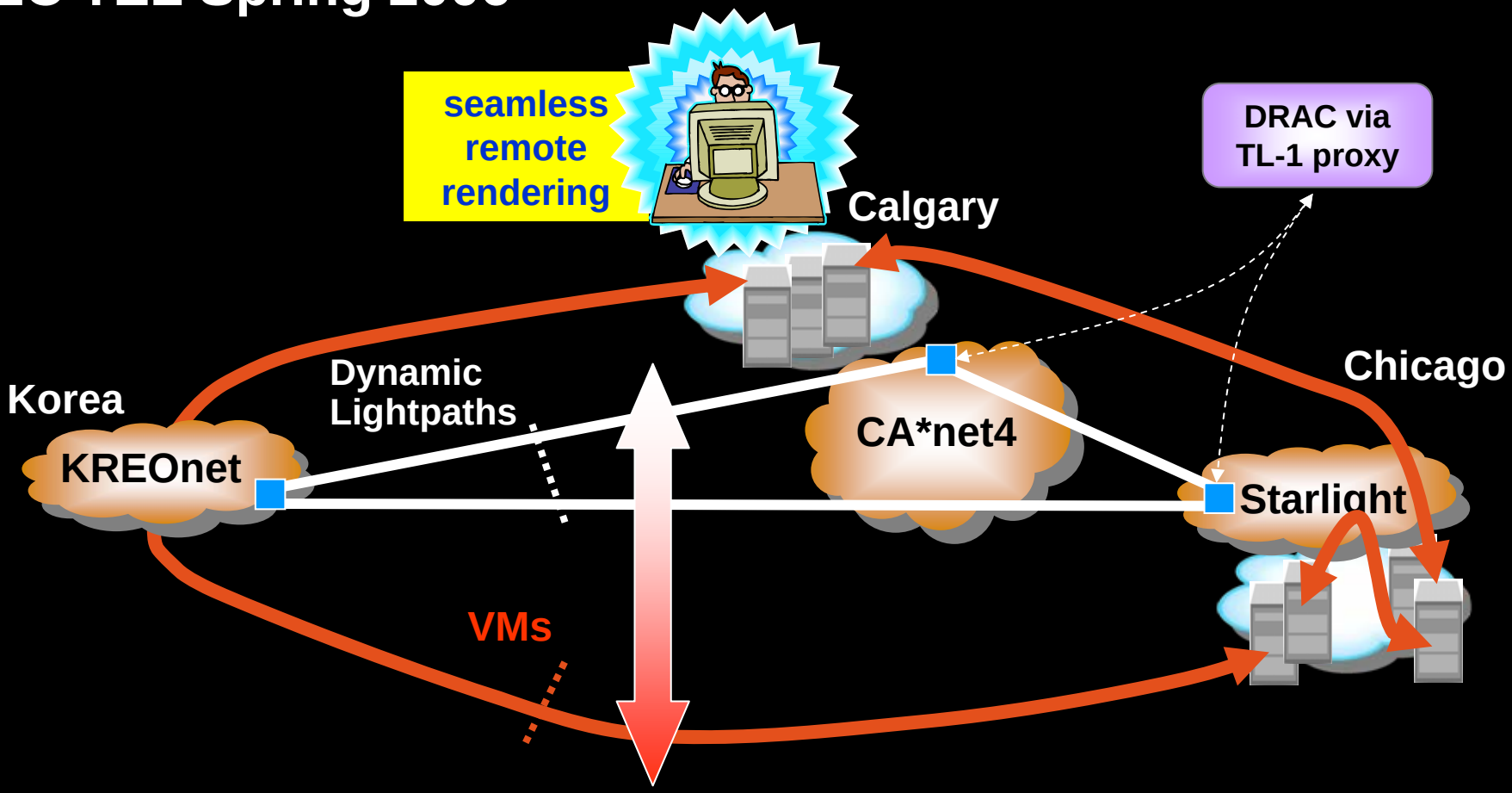
NL Light

STARLIGHT

SURFnet

UvA Universiteit van Amsterdam

The VM Turntable Demonstrator
APEC TEL Spring 2006



The VMs that are live-migrated run an iterative search-refine-search workflow against data stored in different databases at the various locations. A user in Calgary gets seamless rendering of search progress as VMs spin around. Video produced so key message and proof can be propagated eg. TERENA May '06

NORTEL Research and EXPERIMENTAL Networks

> Quest to locate new potential test beds and prototypes where we can stand-up network research ‘experiments’

> Seeking new collaborative and Nortel funded research opportunities

> Investigating new ways to leverage, expand, utilize existing experimental research networks

For more discussion and exploration, contact the program director:

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